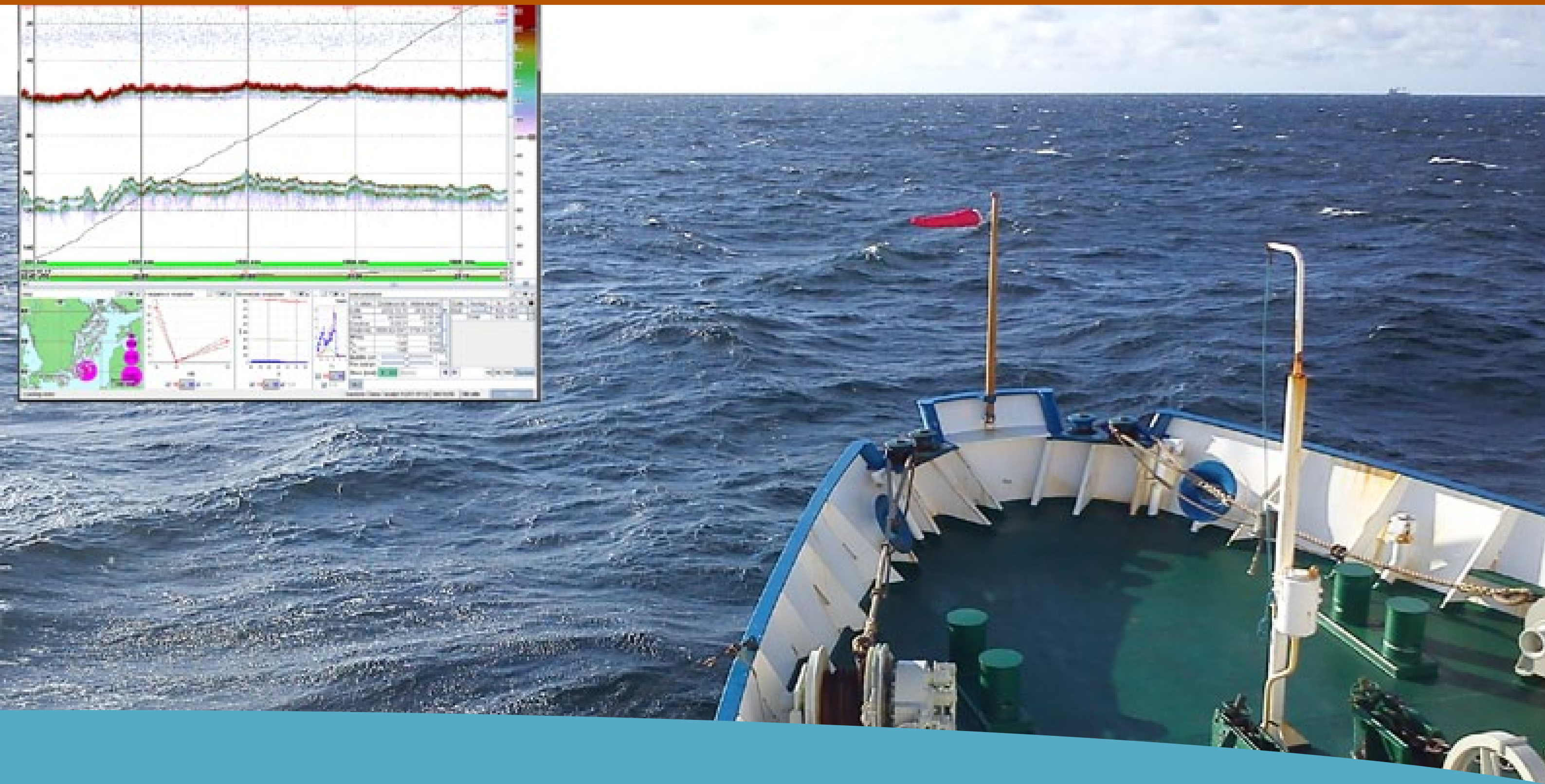

Aqua reports 2018:15

Baltic International Acoustic Survey report, October 2017

Niklas Larson

SLU
Sveriges lantbruksuniversitet
Swedish University of Agricultural Sciences
Department of Aquatic Resources

Baltic International Acoustic Survey report, October 2017

Niklas Larson

Adress:
SLU, Department of Aquatic Resources,
Havsfiskelaboratoriet, Turistgatan 5, 453 30 Lysekil, Sweden

Juny, 2018
SLU, Department of Aquatic Resources

Aqua reports 2018:15
ISBN: 978-91-576-9582-6 (elektronisk version)

This report may be cited as:
Larson, N. (2018) Baltic International Acoustic Survey report, October 2017. Aqua reports 2018:15 Swedish University of Agricultural Sciences, Lysekil, 21 pp.

Download the report from:
http://www.slu.se/aquareports

E-mail:
Scientific Leader: niklas.larson@slu.se

This report has been reviewed by:
Mattias Sköld, SLU and
Malin Werner, SLU

Financed by: The EU-Commission and The Swedish Agency for Marine and Water Management

Photographs on front and back cover: Niklas Larson, Lysekil

Baltic International Acoustic Survey Report for R/V Dana

Survey 2017-10-05 - 2017-10-19

Niklas Larson
SLU - Institute of Marine Research, Lysekil, Sweden

Contents

1 Svensk Sammanfattning

Internationellt koordinerade hydroakustiska expeditioner har regelbundet genomförts av Havsfiskelaboratoriet i Lysekil sedan 1978 i Östersjön. Baltic International Acoustic Survey (BIAS), som utförs varje år i oktober, regleras under Europeiska Commissionens Data Collection Framework (DCF) och är obligatorisk för varje medlemsland i EU runt Östersjön. Sverige ansvarar för subdivision(SD) 27 och för delar av 25, 26, 28 samt 29. Syftet med expeditionen är att bedöma sill samt skarpsillbeståndet och resultaten rapporteras till Baltic International Fish Survey Working Group (WGBIFS) och Baltic Fisheries Assessment Working Group (WGBFAS), båda är arbetsgrupper inom International Council for the Exploration of the Sea (ICES).
I år utfördes kalibrering av ekoloden den 2017-10-05 och 2017-10-06 i Gullmarsfjorden och därefter tog sig Dana till gränsen mellan SD24 och 25 där datainsamlingen startade. Expeditionen slutade 2017-10-19 i Nynäshamn. Under expeditionen samlas akustisk rådata in från ett kalibrerat vetenskapligt ekolod (EK60 38kHz) och pelagisk trålning utförs för att få information om art och längfördelning. Den akustiska rådatan efterbehandlas i LSSS. Trålfångsten analyseras vad gäller arter samt längder, dessutom tar man fram en åldersstruktur på målarterna i fångsten som i detta fallet är sill, skarpsill och torsk. Därefter sammanställs de akustiska värdena med resultatet av analysen av trålfångsterna.
I WGBIFS tas gemensamma riktlinjer och manualer fram och resultaten från varje land kombineras i en gemensam databas som rapporteras till WGBFAS(ICES), vilka använder BIAS-resultaten tillsammans med annan information i en modell för att uppskatta det totala beståndet. Resultatet från 2017 års svenska BIAS survey bedömdes av WGBIFS vara representativt för mängden sill och skarpsill i Östersjön vid mötet i Köpenhamn, 2018. Tidigare års resultat samt mer information kring BIAS samt WGBIFS arbete finns i arbetsgruppens årliga rapport

2 Introduction

International hydroacoustic surveys have been conducted in the Baltic Sea since 1978. The starting point was the cooperation between Institute of Marine Research (IMR) in Lysekil, Sweden and the Institute für Hochseefisherei und Fishverarbeitung in Rostock, German Democratic Republic in October 1978, which produced the first acoustic estimates of total biomass of herring and sprat in the Baltic Main basin (Håkansson *et al.*, 1979). Since then there has been at least one annual hydroacoustic survey for herring and sprat stocks and results have been reported to ICES.
The Baltic International Acoustic Survey (BIAS), is mandatory for the countries that have exclusive economic zone (EEZ) in the Baltic Sea, and is a part of the Data Collection Framework as stipulated by the European Council and the Commission (Council Regulation (EC) No 199/2008 and the Commission Data Collection Framework (DCF) web page[1]).
IMR in Lysekil is part of the Department of Aquatic Resources within Swedish University of Agricultural Sciences and is responsible for the Swedish part of the EU DCF and surveys in the marine environment. The Institute assesses the status of the marine ecosystems, develops and provides biological advices for managers for the sustainable use of aquatic resources.
The BIAS survey are co-ordinated and managed by the ICES working group WGBIFS. The main objective of BIAS is to assess herring and sprat resources in the Baltic Sea. The survey will provide data to the ICES Baltic Fisheries Assessment Working Group (WGBFAS).

[1] https://datacollection.jrc.ec.europa.eu/dcf-legislation

3 Methods

3.1 Narrative

Since R/V Argos was taken out of service in 2011, Sweden has chartered R/V Dana for the BIAS survey. The scientific staff was Swedish and the ship crew was Danish. This year's calibration of the SIMRAD EK60[2] sounder was made at Gullmarsfjorden on the Swedish west coast, the location change occurred 2011 because the normal calibration site at Högön is inaccessible for Dana due to deeper draft. The first part of the cruise started 2017-10-05 between Sweden and Bornholm at the border between ICES subdivision (SD) 24 and SD 25, and ended 2017-10-19 east of Nynäshamn. The total cruise covered SD 27 and parts of 25, 26, 28 and 29.

3.2 Survey design

The stratification is based on ICES statistical rectangles with a range of 0.5 degrees in latitude and 1 degree in longitude (figure 1). The areas of all strata are limited by the 10 m depth line[3]. The aim is to use parallel transects spaced on regular rectangle basis normally at a maximum distance of 15 nautical miles and with a transect density of about 60 nautical miles per 1000 square nautical miles. The irregular shape of the survey area assigned to Sweden and the weather conditions makes it difficult to fulfill this. The total area covered was 20832 square nautical miles and the distance used for acoustic estimates was 1367 nautical miles. The cruise track and positions of trawl hauls are shown in figure 2.

3.3 Calibration

The SIMRAD EK60 echo sounder with the transducer ES38B was calibrated at Bornö in Gullmarssfjorden 2017-10-05 and 2017-10-06 according to the BIAS manual.[3] Values from the calibration were within required accuracy. The change of calibration site was decided after correspondance with Simrad. Due to the distance between the calibration site and the survey area the gain was recalculated using the equation: $\mathrm{G} = \mathrm{G}_0 + 10 * log10(c_0^2/c^2)$ (Bodholt 2002)

3.4 Acoustic data collection

The acoustic sampling was performed around the clock. SIMRAD EK60[2] echo sounder with the 38 kHz transducer (ES38b) mounted on a towed body is used for the acoustic transect data collection, additionally a hull mounted 38 kHz transducer (ES38B) was used during the fishing stations (the towed body is taken aboard when fishing). The settings of the hydroacoustic equipment were as described in the BIAS manual[3]. The post processing of the stored raw data was made using the software LSSS[4]. The mean volume back scattering values (Sv) were integrated over 1 nautical mile elementary sampling distance units (ESDUs) from 10 m below the surface to the bottom. Contributions from air bubbles, bottom structures and scattering layers were removed from the echogram using LSSS.

3.5 Data analysis

The pelagic target species sprat and herring are usually distributed in mixed layers in combination with other species so that it is impossible to allocate the integrator readings to a single species. Therefore the species composition was based on the trawl catch results. For each rectangle the species composition

[2] http://www.simrad.com/ek60
[3] ICES CM 2011/SSGESST:05 Addendum 2
[4] www.marec.no/english/products.htm

and length distribution were determined as the unweighted mean of all trawl results in this rectangle. In the case of lack of sample hauls within an individual ICES rectangle (due to gear problems, bad weather conditions or other limitations) a mean from hauls from neighboring rectangles was used. From these distributions the mean acoustic cross-section was calculated according to the target strength-length (TS) relationships found in table 1.

Clupeoids	TS = 20 log L (cm) - 71.2	(ICES 1983/H:12)
Gadoids	TS = 20 log L (cm) - 67.5	(Foote et al. 1986)
Trachurus trachurus	TS = 20 log L (cm) - 73.0	(Misund, 1997 in Peña, 2007)
Fish without swim bladder	TS = 20 log L (cm) - 84.9	ICES CM2011/SSGESST:02,Addendum 2
Salmonids and 3-spined stickleback were assumed to have the same acoustic properties as herring.		

Table 1: Target strength-length (TS) relationships

The total number of fish (total N) in one rectangle was estimated as the product of the mean area scattering cross section s_A and the rectangle area, divided by the corresponding mean cross section σ. The total number was separated into different fish species according to the mean catch composition in the rectangle.

3.6 Hydrographic data

CTD casts were made with a "Seabird 9+" CTD when calibrating the acoustic instruments and whenever a haul was conducted, additional hydrographic data was collected on a selection of these stations.

3.7 Personnel

The participating scientific crew can be seen in table 2

Eliasson, Rebecca	IMR, Lysekil, Sweden	Fish sampling
Jernberg, Carina	IMR, Lysekil, Sweden	Fish sampling
Johannesson, Per	IMR, Lysekil, Sweden	Technician
Larson, Niklas	IMR, Lysekil, Sweden	Scientific & Expedition leader, Acoustics
Lövgren, Olof	IMR, Lysekil, Sweden	Acoustics
Motyka, Roman	IMR, Lysekil, Sweden	Fish sampling
Palmen-Bratt, Anne-Marie	IMR, Lysekil, Sweden	Fish sampling
Sjöberg, Rajlie	IMR, Lysekil, Sweden	Fish sampling
Svenson, Anders	IMR, Lysekil, Sweden	Expedition leader, Acoustics
Tell, Anna-Kerstin	SMHI, Gothenburg	Oceanography

Table 2: Participating scientific crew

4 Results

4.1 Biological data

In total 46 trawl hauls were carried out, 15 in SD 25, 2 in SD 26, 14 in SD 27, 9 in SD 28 and 6 hauls in SD 29. 2044 herrings and 1294 sprats were aged. Catch compositions by trawl haul is presented in Table 8. Length distributions for herring and sprat by ICES subdivision are shown in figures 3 to 12.

4.2 Acoustic data

The survey statistics concerning the survey area, the mean backscatter [SA], the mean scattering cross section [SIGMA], the estimated total number of fish, the percentages of herring, sprat and cod per Sub-division/rectangle are shown in Table 3.

4.3 Abundance estimates

The total abundances of herring and sprat by age group per rectangle are presented in Table 4 and 6. The corresponding mean weights by age group per rectangle are shown in Tables 5 and 7.

5 Discussion

The data collected during the survey should be considered as representative for the abundance of the pelagic species during the BIAS in 2015 for SD 25 to 29 and thus can be used in the assessment work done by WGBFAS.

6 References

Bodholt, H. The effect of water temperature and salinity on echo sounder measurments. ICES Symposium on Acoustics in Fisheries, Montpellier June 2002, paper no 123.

Foote, K.G., Aglen, A. and Nakken, O. 1986. Measurement of fish target strength with a split-beam echosounder. J.Acoust.Soc.Am. 80(2):612-621.

Håkansson, N.; Kollberg, S.; Falk, U.; Götze, E., Rechlin, O. 1979. A hydroacoustic and trawl survey of herring and sprat stocks of the Baltic proper in October 1978. Fischerei-Forschung, Wissenschaftliche Schriftenreihe 17(2):7-2

ICES. 1983. Report of the 1983 planning group on ICES-coordinated Herring and Sprat Acoustic Surveys, Pelagic Fish Committee CM 1983/H:U. 14 pp.

ICES. 2012. Report of the Baltic International Fish Survey Working Group (WGBIFS) March 2012, Helsinki, Finland. ICES CM 2012/SSGESST:02. 531 pp.

ICES. 2012. Report of the Baltic Fisheries Assessment Working Group 2012 (WGBFAS), 12 - 19 April 2012, ICES Headquarters, Copenhagen. ICES CM 2012/ACOM:10. 859 pp.

Misund, O. A., Beltestad, A. K., Castillo, J., Knudsen, H. P., and Skagen, D. 1997. Distribution and acoustic abundance estimation of horse mackerel, and mackerel in the northern North Sea, October 1996. ICES WG on the assessment of anchovy, horse mackerel, mackerel and sardine, Copenhagen, 9/9-18/9, 1997.

Peña, H. 2008. In situ target-strength measurements of Chilean jack mackerel (Trachurus symmetricus murphyi) collected with a scientific echosounder installed on a fishing vessel. - ICES Journal of Marine Science 65: 594-604.

Council Regulation (EC) No 199/2008:
http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:060:0001:0012:EN:PDF

Commission DCF web page:
http://datacollection.jrc.ec.europa.eu/dcf-legislation

7 Tables, map and figures

SD	RECT	AREA	SA	SIGMA	NTOT	HHer	HSpr	HCod
25	39G4	287.3	573.8	2.746	600.29	51.24	48.11	0.193
25	39G5	979.0	64.5	2.118	298.20	30.37	66.72	0.252
25	40G4	677.2	332.1	4.062	553.61	82.39	13.79	1.521
25	40G5	1012.9	356.8	1.606	2249.42	16.12	67.28	0.012
25	40G6	1013.0	542.4	1.413	3889.96	15.98	59.84	0.110
25	40G7	1013.0	332.9	1.095	3081.10	13.36	35.47	0.086
25	41G6	764.4	466.9	0.944	3781.77	16.56	26.48	0.000
25	41G7	1000.0	1039.3	1.545	6726.96	20.53	69.56	0.013
26	41G8	1000.0	745.0	2.285	3260.41	64.12	28.86	0.021
27	42G6	266.0	456.4	1.347	901.60	47.00	9.24	0.000
27	42G7	986.9	646.4	1.180	5407.80	28.59	59.81	0.000
27	43G7	913.8	479.1	0.688	6366.15	8.65	34.77	0.000
27	44G7	960.5	448.5	0.561	7685.90	19.32	39.16	0.001
27	44G8	456.6	284.3	1.684	770.71	53.90	28.83	0.059
27	45G7	908.7	537.7	1.365	3578.83	56.74	11.97	0.000
27	45G8	947.2	394.9	0.613	6107.18	2.87	52.60	0.001
27	46G8	884.8	715.9	1.182	5358.34	42.99	12.22	0.003
28	42G8	945.4	742.5	0.862	8141.03	15.79	13.06	0.006
28	43G8	296.2	664.9	2.121	928.63	72.82	10.15	0.000
28	43G9	973.7	360.9	0.455	7720.08	0.88	24.97	0.051
28	44G9	876.6	640.6	1.402	4006.07	45.40	7.30	0.002
28	45G9	924.5	917.0	0.882	9609.30	4.88	59.19	0.001
29	46G9	933.8	433.5	0.551	7346.44	9.66	19.54	0.000
29	46H0	933.8	322.4	0.585	5148.96	4.67	47.86	0.005
29	47G9	876.2	1405.1	1.465	8405.73	49.91	40.08	0.012

Table 3: Survey statistics, see chapter 4.2 for more info

SD	RECT	NSprTOT	NSpr0	NSpr1	NSpr2	NSpr3	NSpr4	NSpr5	NSpr6	NSpr7	NSpr8
25	39G4	288.78	0.00	28.38	11.35	140.55	66.77	7.68	20.03	9.35	4.67
25	39G5	198.97	0.00	9.41	13.59	81.39	70.41	18.54	3.50	0.56	1.57
25	40G4	76.37	0.37	8.52	0.72	33.81	17.27	5.29	7.34	0.34	2.70
25	40G5	1513.32	0.00	37.01	130.57	746.98	277.54	267.90	53.32	0.00	0.00
25	40G6	2327.78	19.40	136.01	121.87	1746.00	40.33	79.14	97.02	11.83	76.19
25	40G7	1092.78	18.93	91.17	23.50	571.36	90.00	41.13	109.67	104.64	42.37
25	41G6	1001.38	60.24	20.61	190.07	452.01	75.40	155.93	14.24	18.63	14.24
25	41G7	4679.07	40.68	53.83	0.00	3496.77	683.64	350.15	6.83	33.80	13.37
26	41G8	940.87	7.18	142.93	89.99	480.12	48.78	70.56	0.00	36.65	64.66
27	42G6	83.29	0.50	5.12	4.62	48.97	12.24	1.40	3.11	5.92	1.40
27	42G7	3234.52	703.39	46.09	293.75	1638.88	279.72	235.22	30.42	0.00	7.04
28	42G8	1063.59	151.58	45.08	78.46	607.15	101.91	67.66	0.00	6.87	4.89
27	43G7	2213.37	1093.33	247.07	321.30	424.12	95.87	15.87	2.57	2.57	10.65
28	43G8	94.23	4.16	0.00	10.00	64.87	10.31	3.64	0.73	0.00	0.52
28	43G9	1927.45	1727.82	48.73	51.89	85.12	1.47	0.00	1.05	11.37	0.00
27	44G7	3009.87	2679.09	67.05	85.26	170.74	5.15	0.00	0.00	0.00	2.58
27	44G8	222.17	82.19	4.23	14.65	109.86	5.86	1.63	0.00	0.00	3.74
28	44G9	292.62	132.21	17.31	8.12	116.64	0.93	12.66	3.82	0.00	0.93
27	45G7	428.46	296.70	18.13	11.99	89.15	7.88	2.90	0.00	0.86	0.86
27	45G8	3212.25	2202.54	170.60	164.33	548.73	77.00	39.95	9.10	0.00	0.00
28	45G9	5687.39	1659.98	205.43	403.57	2189.41	889.88	249.68	47.36	12.62	29.46
27	46G8	654.85	347.78	19.19	39.19	216.90	1.23	9.81	13.05	3.24	4.46
29	46G9	1435.85	1352.31	0.00	16.67	42.81	4.72	5.84	1.87	0.00	11.64
29	46H0	2464.27	2114.60	48.60	45.56	210.68	12.30	26.41	0.00	1.35	4.78
29	47G9	3369.38	1928.21	236.14	45.21	1088.53	14.62	17.93	5.98	14.62	18.13

Table 4: Estimated number (millions) of sprat (Nspr0 stands for number of 0 year old sprat)

SD	RECT	WSpr0	WSpr1	WSpr2	WSpr3	WSpr4	WSpr5	WSpr6	WSpr7	WSpr8
25	39G4		12.75	11.50	13.60	16.78	18.00	15.50	12.00	20.50
25	39G5		11.50	12.00	12.50	14.67	15.86	17.75	16.00	18.00
25	40G4	2.00	13.33	10.00	12.29	14.78	16.00	16.25	17.00	18.00
25	40G5		8.67	8.57	11.69	13.43	13.57	14.50		
25	40G6	3.25	8.00	8.50	10.25	14.50	13.75	14.40	15.00	15.86
25	40G7	3.29	9.50	9.50	11.45	13.75	14.80	13.75	12.00	14.75
25	41G6	3.03	6.57	7.75	8.87	12.67	13.50	11.00	12.00	12.00
25	41G7	3.40	8.00		10.33	11.14	12.50	15.00	14.50	16.00
26	41G8	2.67	8.33	9.67	10.47	13.40	13.40		12.50	13.67
27	42G6	3.00	9.00	8.00	9.68	12.00	16.00	11.00	12.50	13.50
27	42G7	2.90	7.67	8.67	10.13	13.00	13.00	12.50		13.00
28	42G8	2.81	9.00	9.00	9.33	12.67	13.00		16.00	13.00
27	43G7	2.55	8.00	9.60	10.71	12.33	11.50	12.00	11.00	13.50
28	43G8	3.12		8.60	10.00	12.20	12.75	13.00		14.00
28	43G9	2.45	8.14	9.50	10.08	11.00		11.00	13.00	
27	44G7	2.33	8.00	9.50	9.57	12.50				14.00
27	44G8	2.59	8.00	10.75	9.70	11.50	13.00			12.50
28	44G9	2.87	8.40	7.50	9.71	12.00	11.60	13.00		15.00
27	45G7	2.69	7.50	9.67	9.25	10.50	11.67		13.00	13.00
27	45G8	2.75	7.38	9.75	10.00	12.40	12.00	12.00		
28	45G9	2.74	8.00	10.00	9.43	10.80	12.83	14.00	12.00	13.00
27	46G8	2.30	7.33	8.33	9.50	12.00	12.00	11.50	12.00	12.00
29	46G9	2.50		7.60	8.85	9.00	11.33	11.00		10.33
29	46H0	2.75	7.12	9.00	9.27	10.00	12.14		13.00	11.50
29	47G9	2.26	7.50	8.00	9.33	10.00	11.67	10.00	10.00	10.50

Table 5: Estimated mean weights (g) of sprat
(Wspr1 stands for average weight of the 1 year old sprat)

SD	RECT	NHerTOT	NHer0	NHer1	NHer2	NHer3	NHer4	NHer5	NHer6	NHer7	NHer8
25	39G4	307.56	1.68	5.58	14.19	152.83	62.80	53.97	13.96	0.00	2.56
25	39G5	90.56	0.89	3.75	3.37	31.97	15.82	20.99	6.82	5.96	1.00
25	40G4	456.13	0.00	5.90	47.49	123.51	107.83	106.65	15.48	37.63	11.64
25	40G5	362.62	0.00	10.42	3.74	162.25	99.35	37.76	22.87	22.02	4.21
25	40G6	605.64	19.93	6.64	53.08	312.40	121.77	56.38	24.22	2.27	8.94
25	40G7	411.74	8.20	7.93	17.38	242.00	41.51	52.64	22.57	16.42	3.09
25	41G6	626.37	98.82	47.50	10.58	394.21	39.39	31.64	4.12	0.00	0.11
25	41G7	1381.06	16.42	34.94	214.13	917.67	79.10	71.54	41.61	4.77	0.88
26	41G8	2090.42	18.56	4.84	127.51	723.08	467.42	586.05	121.07	4.84	37.04
27	42G6	423.74	67.41	23.89	9.16	236.24	65.77	19.63	1.64	0.00	0.00
27	42G7	1546.04	884.70	35.78	111.67	382.18	115.33	9.84	4.65	1.89	0.00
28	42G8	1285.72	20.30	0.00	182.01	811.02	56.92	132.88	60.93	12.75	8.91
27	43G7	550.45	186.52	77.00	69.89	146.37	37.35	25.67	2.63	2.39	2.63
28	43G8	676.21	0.00	3.74	57.80	389.08	97.08	63.41	47.14	5.61	12.35
28	43G9	68.24	8.91	0.00	5.15	40.17	5.58	8.43	0.00	0.00	0.00
27	44G7	1484.85	1314.75	35.30	20.10	68.53	27.41	8.53	5.78	4.46	0.00
27	44G8	415.43	7.32	25.60	49.70	283.11	43.37	4.82	1.51	0.00	0.00
28	44G9	1818.72	19.50	52.46	339.51	1143.87	132.49	53.38	61.55	10.95	5.01
27	45G7	2030.59	221.87	425.49	228.17	999.11	143.25	4.92	2.87	4.92	0.00
27	45G8	174.97	81.25	37.08	5.78	30.85	8.88	7.52	3.62	0.00	0.00
28	45G9	468.65	76.13	48.19	52.31	238.90	34.08	16.11	2.92	0.00	0.00
27	46G8	2303.41	50.03	375.28	406.12	1401.72	34.27	35.99	0.00	0.00	0.00
29	46G9	709.97	131.80	127.22	85.10	316.50	39.22	2.64	7.49	0.00	0.00
29	46H0	240.23	63.82	22.99	33.50	74.79	23.72	16.19	4.05	1.16	0.00
29	47G9	4195.26	144.16	616.69	771.73	2183.50	268.27	121.04	58.55	19.68	11.64

Table 6: Estimated number (millions) of herring

SD	RECT	WHer0	WHer1	WHer2	WHer3	WHer4	WHer5	WHer6	WHer7	WHer8
25	39G4	3.50	18.50	36.00	48.67	59.19	51.25	50.40		65.00
25	39G5	13.00	23.80	41.50	38.21	46.11	45.41	51.38	52.82	67.00
25	40G4		25.50	47.33	46.52	70.75	68.61	89.50	66.50	92.67
25	40G5		25.50	42.50	31.59	41.81	49.46	59.23	50.17	58.00
25	40G6	7.94	17.00	28.25	30.21	40.86	47.10	50.14	70.00	48.75
25	40G7	9.25	27.00	27.25	32.75	50.30	46.60	48.38	57.25	60.67
25	41G6	6.04	20.50	32.75	28.94	32.75	38.60	42.50		81.00
25	41G7	5.89	19.50	23.25	28.81	37.00	41.67	43.71	49.33	54.00
26	41G8	4.33	51.00	29.50	26.05	31.73	40.21	45.71	47.00	50.80
27	42G6	5.60	19.33	19.00	26.27	32.45	36.62	44.00		
27	42G7	5.15	17.00	24.88	25.33	32.40	32.33	37.00	49.00	
28	42G8	4.00		23.83	27.32	36.50	38.22	41.83	47.33	43.00
27	43G7	4.49	16.85	23.00	25.53	30.20	36.33	30.00	44.00	29.00
28	43G8		16.00	22.00	24.92	33.50	36.90	40.88	47.00	45.33
28	43G9	3.91		22.33	26.08	29.00	32.75			
27	44G7	4.29	15.89	21.80	23.47	26.14	27.17	31.00	26.00	
27	44G8	3.89	17.43	27.25	26.35	30.60	37.50	58.00		
28	44G9	5.20	17.80	24.60	26.90	37.25	39.17	37.57	53.33	44.00
27	45G7	3.97	15.40	24.00	24.00	30.22	29.00	44.00	26.00	
27	45G8	4.18	15.73	21.33	23.43	27.25	29.25	27.00		
28	45G9	3.46	15.67	18.80	24.36	26.80	30.60	33.00		
27	46G8	3.17	14.50	24.00	22.60	31.25	29.00			
29	46G9	3.28	12.77	20.67	21.09	28.70	32.00	34.33		
29	46H0	3.41	15.17	21.17	24.11	28.62	31.44	39.67	39.00	
29	47G9	3.03	13.62	21.00	23.57	27.83	31.40	24.00	35.33	26.00

Table 7: Estimated mean weights (g) of herring

	Species	3	5	7	9	11	13	15	17
1	Anguilla anguilla								
2	Clupea harengus	58.47	74.89	32.70	25.95	31.82	19.48	72.25	1.16
3	Cyclopterus lumpus				0.24	0.12			1.56
4	Enchelyopus cimbrius								
5	Gadus morhua	2.38	18.61	0.00	0.23	0.15	2.02	0.28	
6	Gasterosteus aculeatus		0.01	0.01	0.00		0.14	5.18	29.69
7	Hyperoplus lanceolatus								
8	Leptoclinus maculatus								
9	Merlangius merlangus	0.94	0.84						
10	Myoxocephalus quadricornis								
11	Myoxocephalus scorpius								0.22
12	Nerophis ophidion								0.00
13	Osmerus eperlanus								
14	Platichthys flesus	0.12							
15	Pleuronectes platessa					0.09			
16	Pomatoschistus			0.00					
17	Pungitius pungitius		0.00				0.00	0.03	0.25
18	Scomber scombrus								
19	Scophthalmus maximus								
20	Sprattus sprattus	18.57	4.13	0.93	89.18	23.48	16.82	42.04	3.27
21	Zoarces viviparus								

Table 8: Catch composition per haul.

	Species	19	21	23	25	27	29	31	33
1	Anguilla anguilla								0.08
2	Clupea harengus	122.28	75.97	151.25	24.12	27.93	272.06	518.15	513.25
3	Cyclopterus lumpus	0.35	0.98	0.23					0.64
4	Enchelyopus cimbrius								
5	Gadus morhua		7.99	6.33	0.10			0.80	0.15
6	Gasterosteus aculeatus	28.95	0.71	4.12	7.23	3.81	9.94	14.22	6.43
7	Hyperoplus lanceolatus			0.21					
8	Leptoclinus maculatus								
9	Merlangius merlangus		0.18						
10	Myoxocephalus quadricornis								
11	Myoxocephalus scorpius								
12	Nerophis ophidion								
13	Osmerus eperlanus								
14	Platichthys flesus				0.31				
15	Pleuronectes platessa								
16	Pomatoschistus			1.62	0.09				
17	Pungitius pungitius	0.04		0.04	0.01	0.01	0.05	0.03	0.03
18	Scomber scombrus				0.29				
19	Scophthalmus maximus								
20	Sprattus sprattus	150.84	100.73	219.49	7.42	387.27	195.07	232.26	117.61
21	Zoarces viviparus								

Table 8 (continued): Catch composition per haul

	Species	35	37	39	41	43	45	47	49
1	Anguilla anguilla								
2	Clupea harengus	216.30	0.39	77.42	971.46	701.49	52.87	0.05	23.08
3	Cyclopterus lumpus				0.73		0.50	0.11	
4	Enchelyopus cimbrius			0.03					
5	Gadus morhua	0.68		0.39		0.00		0.02	0.04
6	Gasterosteus aculeatus	0.43	69.39	8.06	15.01	4.48	36.38	116.61	66.39
7	Hyperoplus lanceolatus								0.04
8	Leptoclinus maculatus								
9	Merlangius merlangus								
10	Myoxocephalus quadricornis					0.37			
11	Myoxocephalus scorpius				0.17	0.18			
12	Nerophis ophidion								
13	Osmerus eperlanus								
14	Platichthys flesus				0.67	0.24			0.15
15	Pleuronectes platessa								
16	Pomatoschistus					0.02			
17	Pungitius pungitius		0.06		0.03				0.01
18	Scomber scombrus								
19	Scophthalmus maximus								
20	Sprattus sprattus	19.80	0.27	20.91	48.19	15.28	10.91	29.47	76.24
21	Zoarces viviparus				0.03				

Table 8 (continued): Catch composition per haul

	Species	51	53	55	57	59	61	63	65
1	Anguilla anguilla								
2	Clupea harengus	189.40	241.38	32.88	34.22	57.01	67.50	46.17	70.17
3	Cyclopterus lumpus					0.14			
4	Enchelyopus cimbrius								
5	Gadus morhua						0.07		0.27
6	Gasterosteus aculeatus	11.15	18.96	1.51	44.26	30.57	49.80	23.76	1.88
7	Hyperoplus lanceolatus						0.12		
8	Leptoclinus maculatus								
9	Merlangius merlangus								
10	Myoxocephalus quadricornis								
11	Myoxocephalus scorpius					0.16			
12	Nerophis ophidion				0.02				
13	Osmerus eperlanus								
14	Platichthys flesus								
15	Pleuronectes platessa								
16	Pomatoschistus								
17	Pungitius pungitius					0.03			
18	Scomber scombrus								
19	Scophthalmus maximus								
20	Sprattus sprattus	192.09	22.10	80.94	127.35	23.52	64.22	56.52	10.98
21	Zoarces viviparus			0.04					

Table 8 (continued): Catch composition per haul

	Species	67	69	71	73	75	77	79	81
1	Anguilla anguilla								
2	Clupea harengus	25.78	170.08	455.47	38.89	74.57	56.87	142.99	24.80
3	Cyclopterus lumpus	0.67	0.20	0.03	0.18		0.46	0.13	0.16
4	Enchelyopus cimbrius								
5	Gadus morhua	0.07					0.01		0.45
6	Gasterosteus aculeatus	54.55	9.70	18.59	94.76	8.60	103.94	61.11	56.14
7	Hyperoplus lanceolatus		0.05				0.04	0.03	
8	Leptoclinus maculatus								
9	Merlangius merlangus								
10	Myoxocephalus quadricornis								
11	Myoxocephalus scorpius	0.35						0.24	
12	Nerophis ophidion								
13	Osmerus eperlanus			0.02					
14	Platichthys flesus								
15	Pleuronectes platessa								
16	Pomatoschistus								
17	Pungitius pungitius	0.04		0.02		0.02		0.06	
18	Scomber scombrus								
19	Scophthalmus maximus		0.31						
20	Sprattus sprattus	253.77	7.42	25.91	161.54	482.35	72.43	224.27	68.07
21	Zoarces viviparus								

Table 8 (continued): Catch composition per haul

	Species	83	85	87	89	91
1	Anguilla anguilla					
2	Clupea harengus	1.25	300.64	537.01	99.98	0.64
3	Cyclopterus lumpus	0.26	0.63		0.14	0.24
4	Enchelyopus cimbrius					
5	Gadus morhua			0.68		
6	Gasterosteus aculeatus	55.69	31.04	0.36	33.83	94.54
7	Hyperoplus lanceolatus					
8	Leptoclinus maculatus			0.00		
9	Merlangius merlangus					
10	Myoxocephalus quadricornis			0.17		
11	Myoxocephalus scorpius					
12	Nerophis ophidion					0.02
13	Osmerus eperlanus					
14	Platichthys flesus			0.40	0.13	
15	Pleuronectes platessa					
16	Pomatoschistus					
17	Pungitius pungitius		0.06		0.02	0.06
18	Scomber scombrus					
19	Scophthalmus maximus					
20	Sprattus sprattus	19.75	280.13	45.25	18.57	18.15
21	Zoarces viviparus					

Table 8 (continued): Catch composition per haul

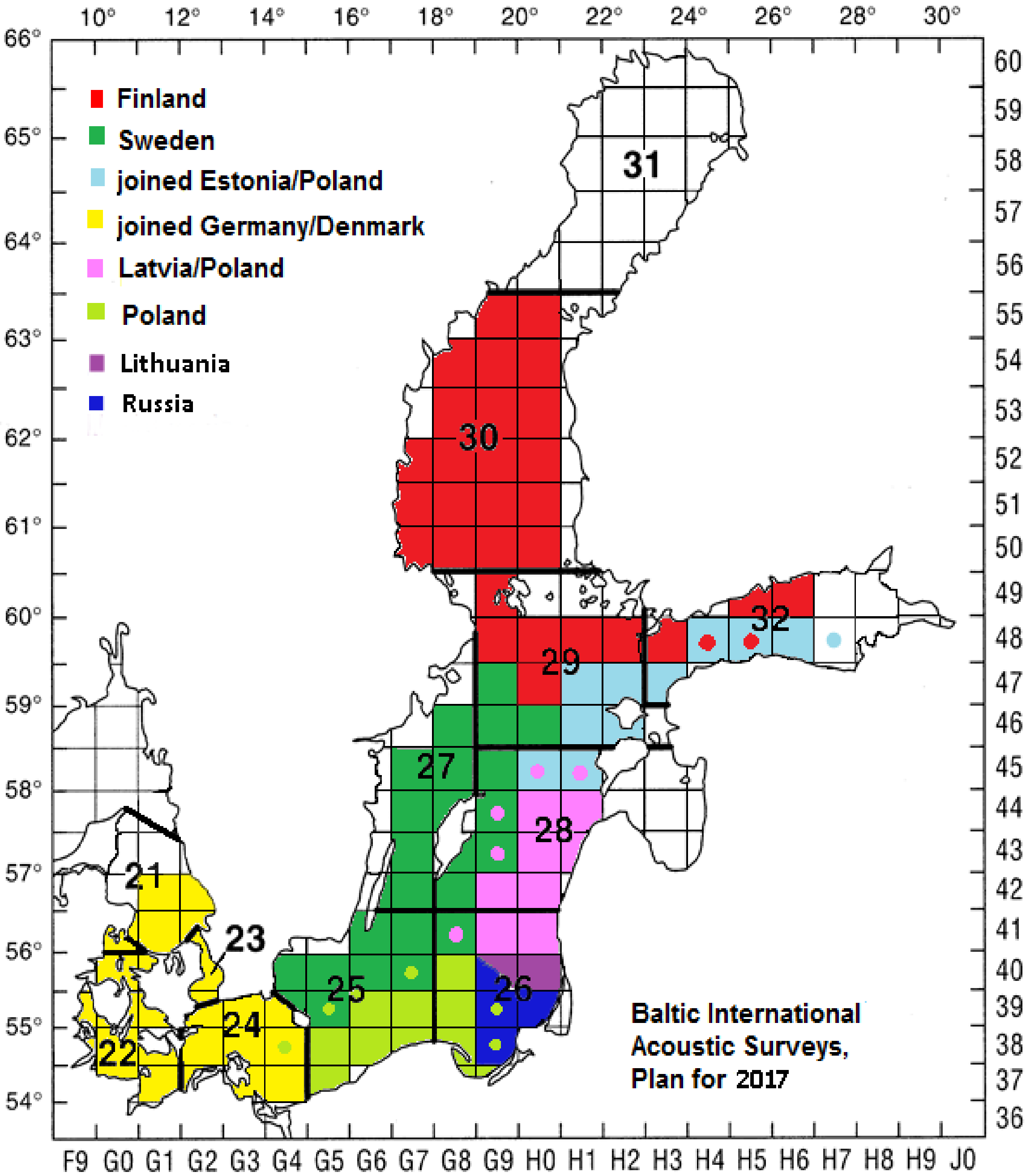

Figure 1: Map over which ICES square are allocated to each country (On axes: longitude, latitude and ICES name of square eg:41G8)

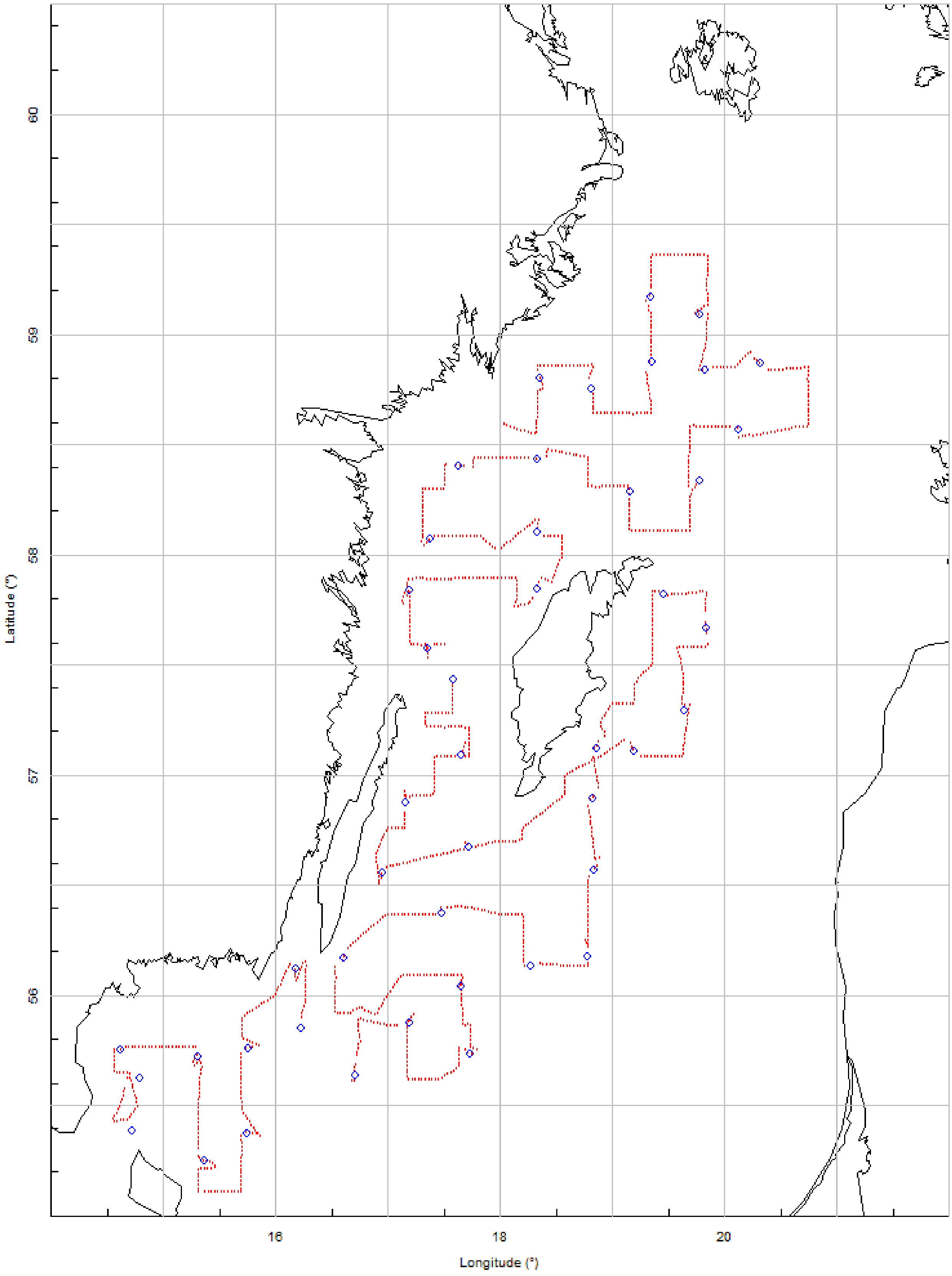

Figure 2: cruise track(red), positions of trawl hauls (blue) and survey grid (ICES squares)(grey)

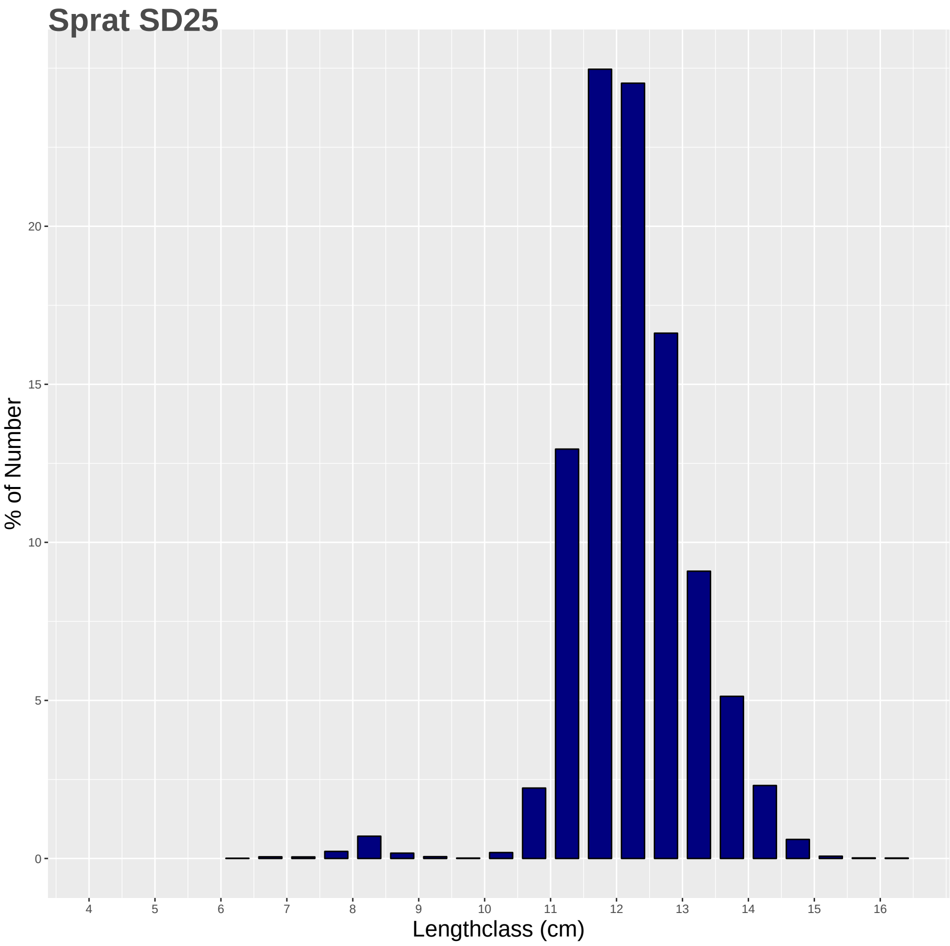

Figure 3: Length distribution of sprat from subdivision 25

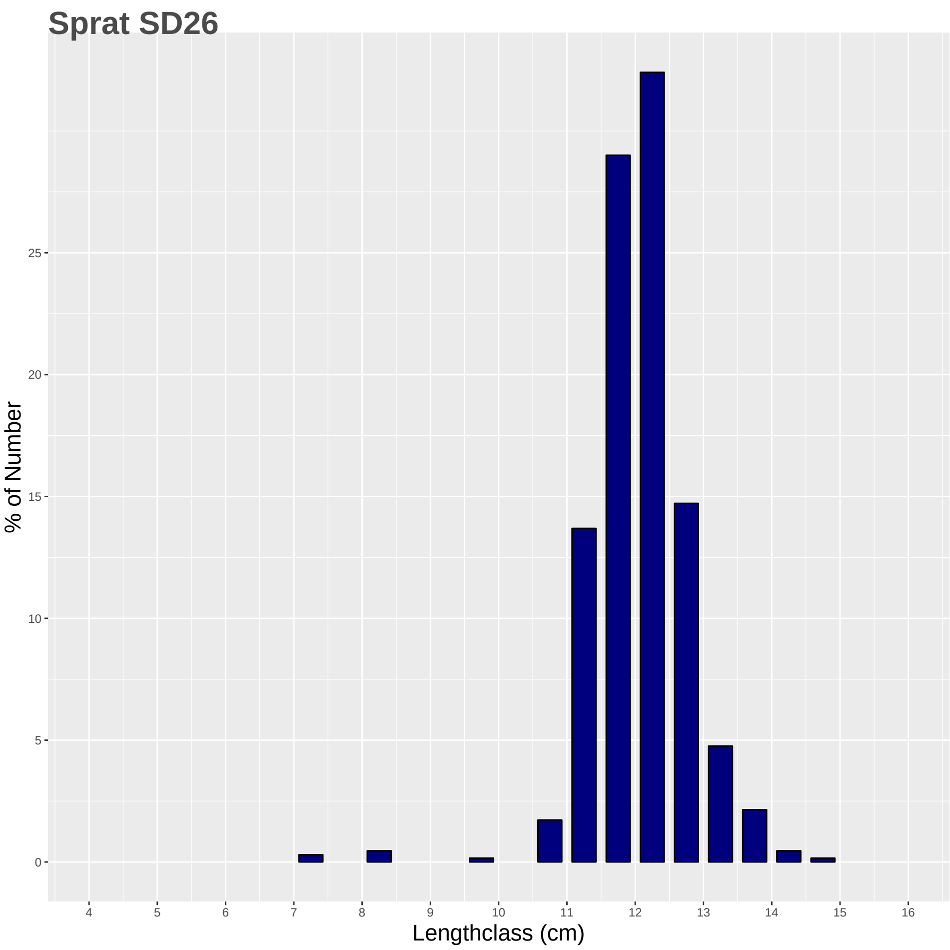

Figure 4: Length distribution of sprat from subdivision 26

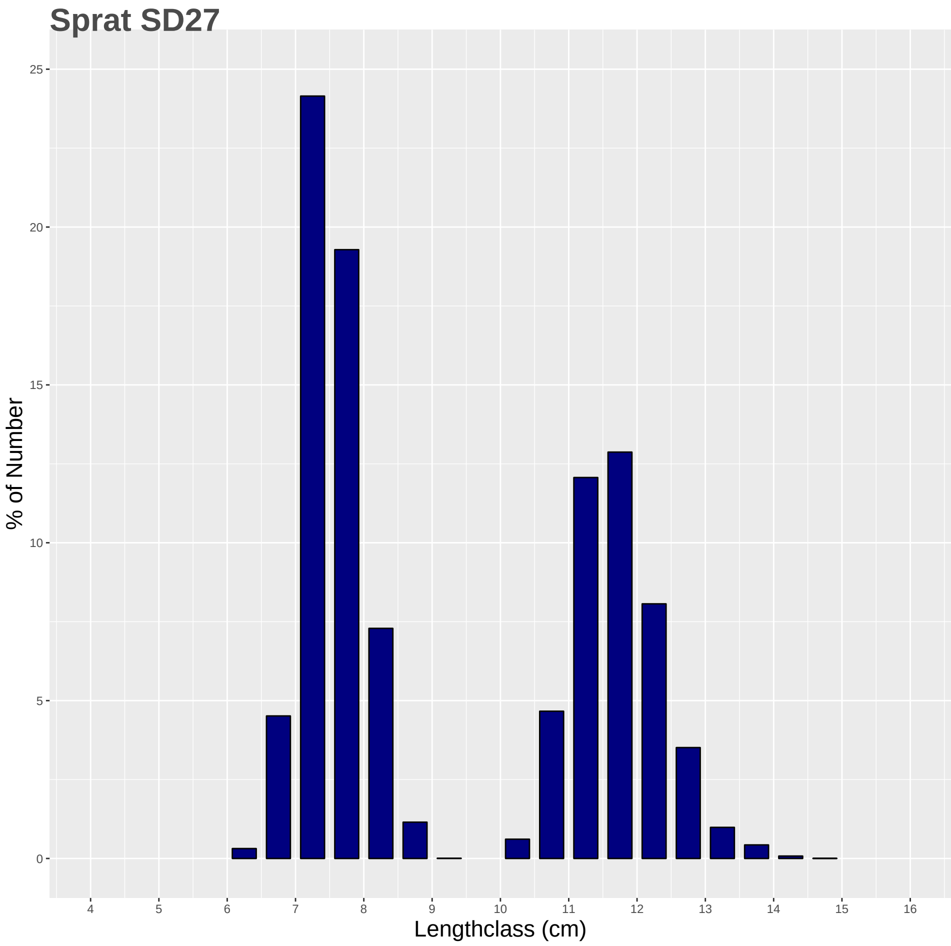

Figure 5: Length distribution of sprat from subdivision 27

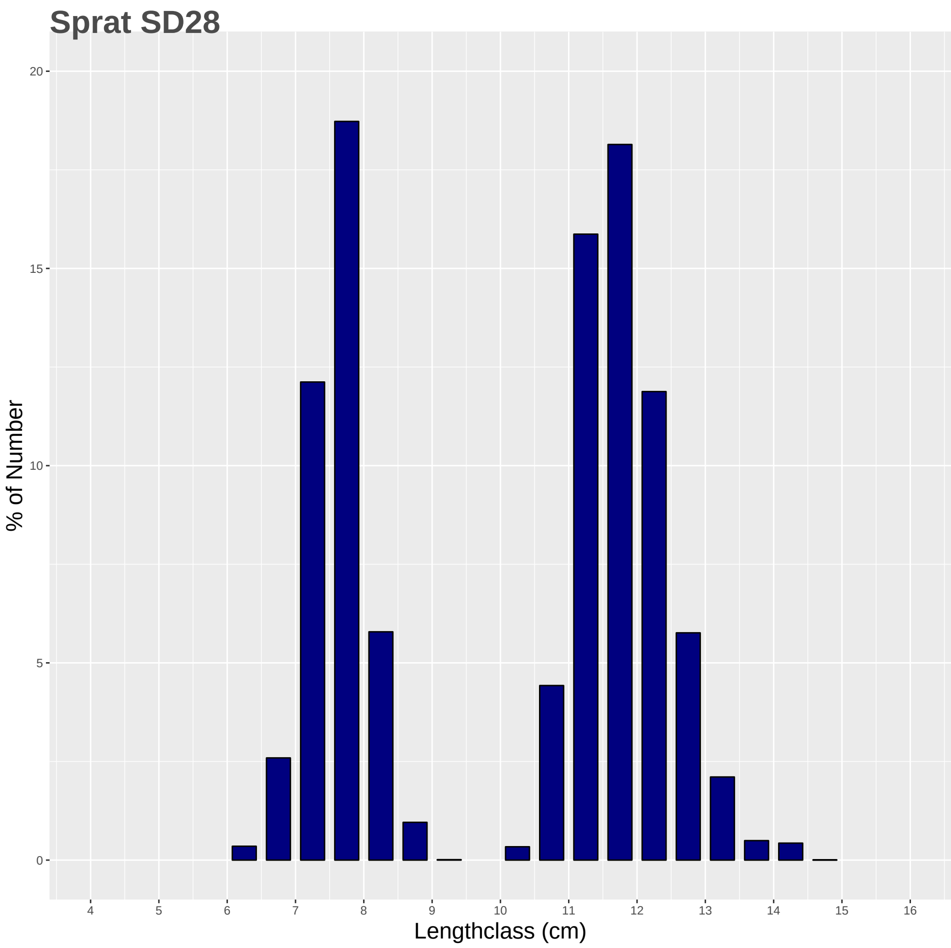

Figure 6: Length distribution of sprat from subdivision 28

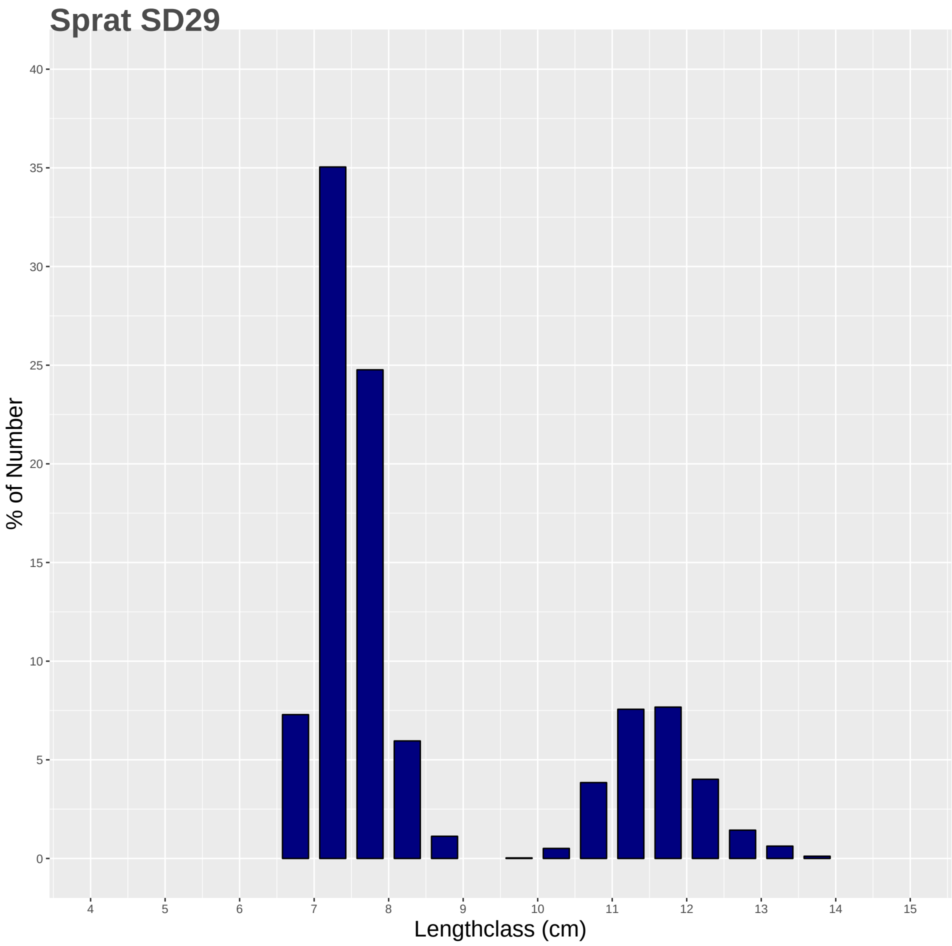

Figure 7: Length distribution of sprat from subdivision 29

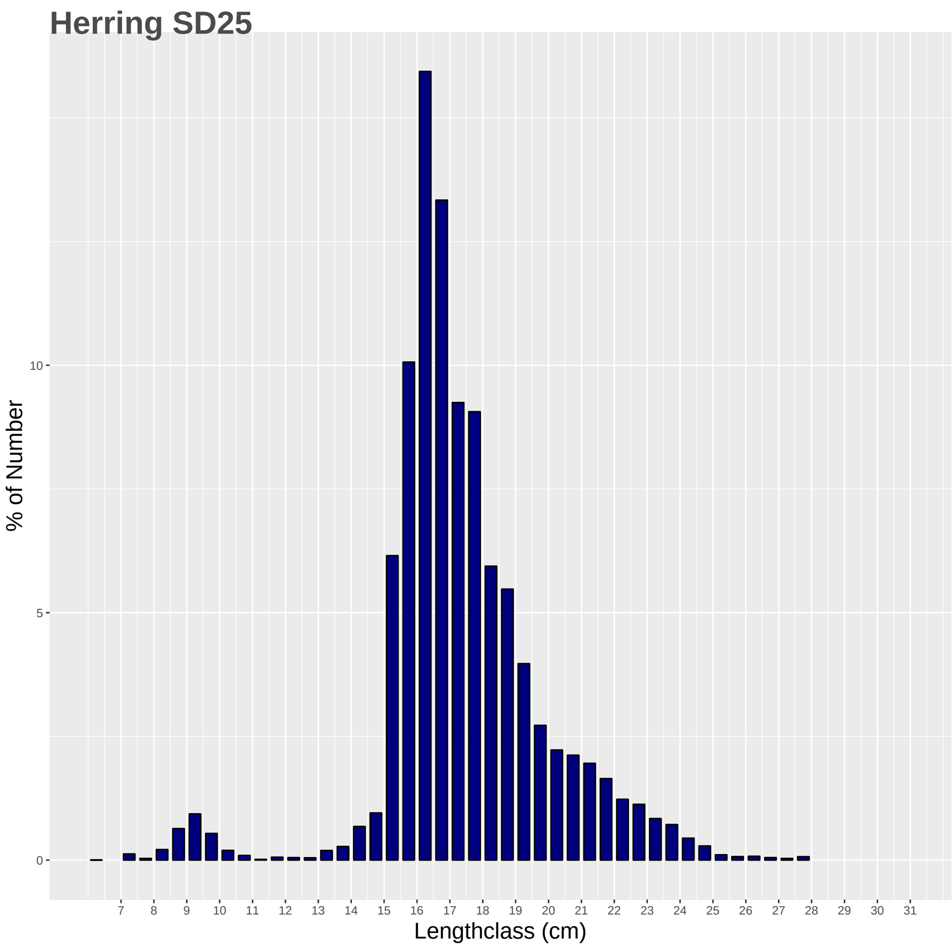

Figure 8: Length distribution of herring from subdivision 25

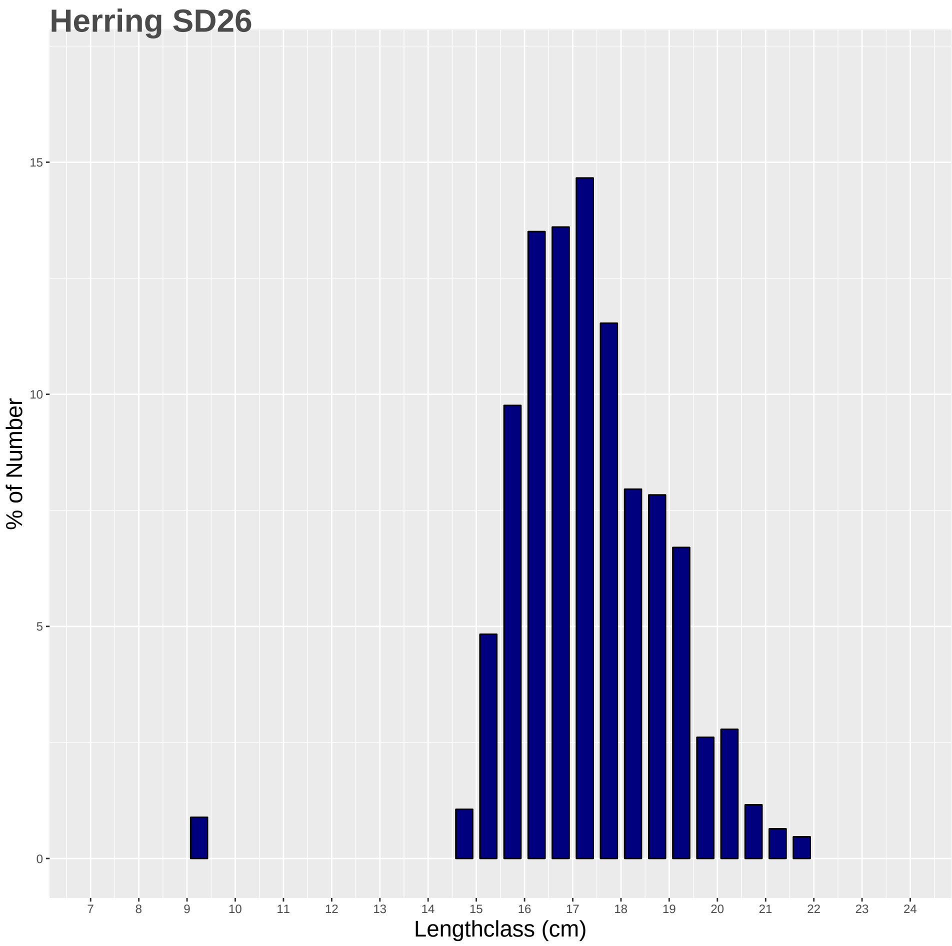

Figure 9: Length distribution of herring from subdivision 26

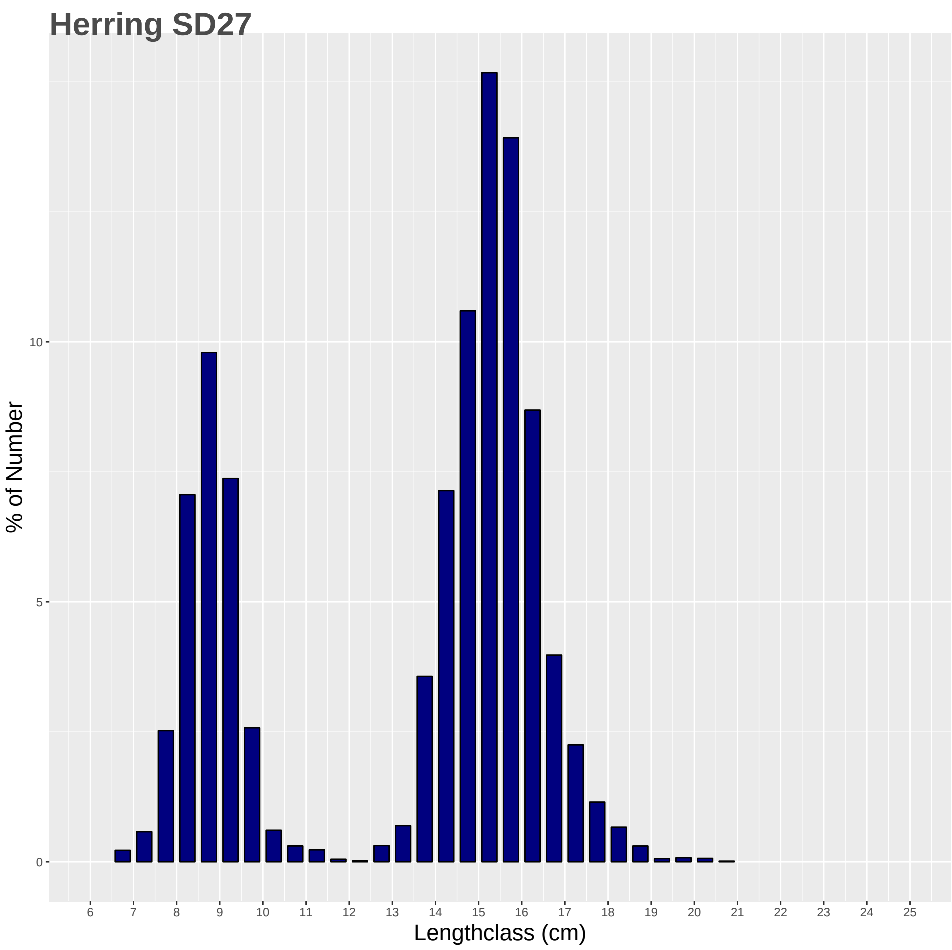

Figure 10: Length distribution of herring from subdivision 27

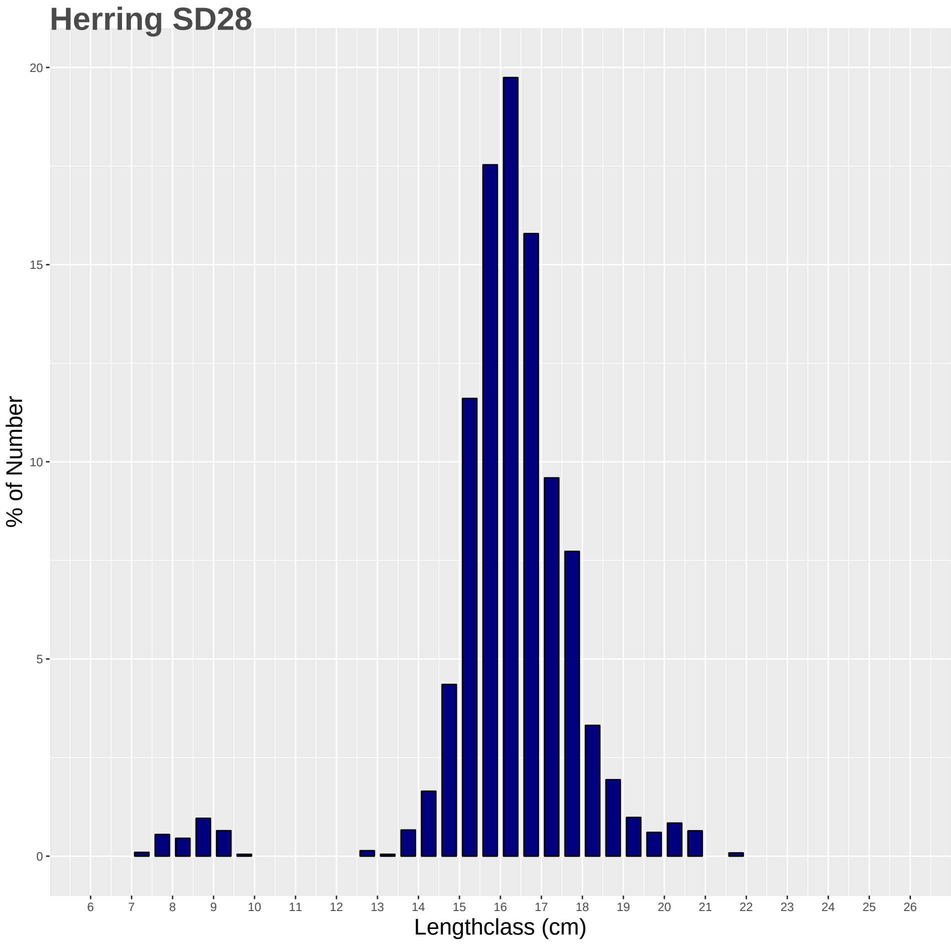

Figure 11: Length distribution of herring from subdivision 28

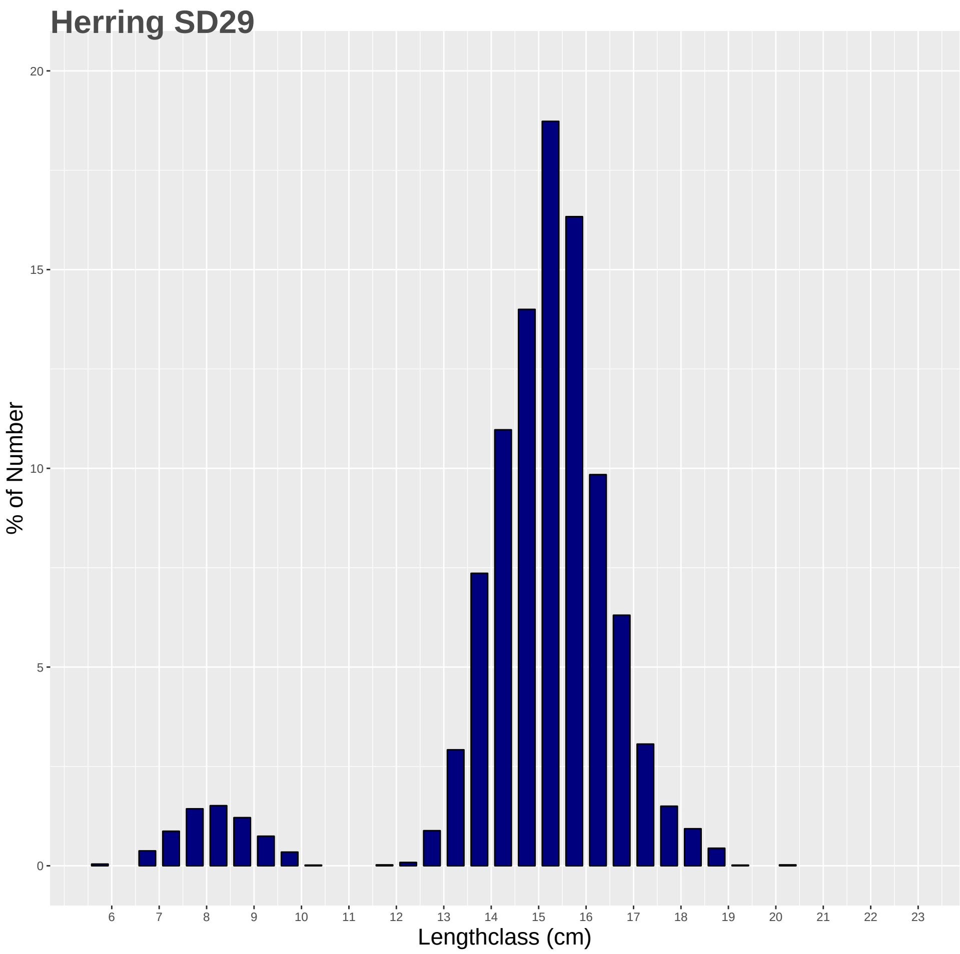

Figure 12: Length distribution of herring from subdivision 29